CLAIMS

What is claimed:

1. A catalytic system comprising a tethered catalyst composition or a tethered chiral auxiliary disposed in a microchannel.

2. A method of converting a reactant to a product, comprising

passing a reactant fluid composition into a microchannel;

wherein the microchannel contains a tethered catalyst or a tethered chiral auxiliary; and

reacting the reactant to form a product.

3. The catalytic system of claim 1 wherein the system comprises a tethered catalyst composition, and the tethered catalyst composition defines at least one wall of a bulk flow path in the microchannel.

4. The catalytic system of claim 3, wherein at least one heat transfer microchannel is adjacent to at least one wall of the microchannel.

5. The catalytic system of claim 1 wherein said tethered catalyst composition or tethered chiral auxiliary is provided as, or part of, a porous insert.

6. The catalytic system of claim 5, wherein said porous insert is adjacent at least one wall of the microchannel, and at least one heat transfer microchannel is adjacent said at least one wall of a microchannel.

7. The catalytic system of claim 1, wherein said tethered catalyst composition or tethered chiral auxiliary comprises a solid support selected from the group consisting of: solid inorganic oxide, carbon, polymer, silica, alumina, clay, zeolite and mesoporous solid.

8. The catalytic system of claim 1, wherein the system comprises a tethered catalyst composition in which a tether comprises at least a three atom chain that connects a metal center with a surface oxygen.

9. The catalytic system of claim 8, wherein the tethered catalyst composition comprises one or more member selected from the group consisting of metal, metal coordination complex, organometallic complex, oxidant, reductant, acid, and base.

10. The method of claim 2 further characterized by either (1) superior mass transfer characteristics, or (2) superior control of residence time, or (3) superior yield.

11. The system of claim 1 further comprising a micromixer positioned to mix reactants prior to passage into the microchannel.

12. The method of claim 2 wherein the microchannel comprises a tethered catalyst composition and further comprising the step of quenching the product immediately after passing in contact with the tethered catalyst.

13. The method of claim 2 comprising C-C bond formation.

14. The method of claim 13 comprising a Friedel Crafts reaction.

15. The method of claim 13 comprising a Heck reaction.

16. The method of claim 13 comprising oligomerization or polymerization.

17. The method of claim 2 comprising a reduction.

18. The method of claim 17 wherein a chiral compound is formed in greater than 90% enantioselectivity.

19. The method of claim 2 comprising an enantiomeric addition with a greater than 70% enantioselectivity.

20. The method of claim 2 comprising an oxidation.

21. The method of claim 2 comprising an epoxidation.

22. The method of claim 13 comprising a Knoevenagel condensation.

23. The method of claim 2 comprising a reaction selected from the group consisting of: hydrogenation, dehydrogenation, hydrogenolysis, hydroformylation, hydrosilation, oxidation, reduction, isomerization, aromatization, hydrocyanation, olefin metathesis, carbonylation, decarbonylation, carboxylation, epoxidation, oxygen insertion reactions, oxidation of alcohols to carbonyls and carboxylic acids, olefin polymerization, oxygen transfer, hydrogen transfer, hydrogenation of imines, nitrogen transfer, Heck Reaction, alkylation, amination, cyclopropanation, addition reactions, condensation, hydration, dihydroxylation of olefins, dehydration, Suzuki reaction, Buchwald-Hartig Reaction, Sonogashira Reaction, cross coupling reactions, and esterification.

24. The catalytic system of claim 1 wherein the microchannel comprises at least one wall and a tethered catalyst or a tethered chiral auxiliary is coated on the wall of the microchannel.

25. The method of claim 2 wherein a chiral compound is formed in greater than 90% enantioselectivity.

26. The method of claim 13 comprising a Michael addition.

27. The method of claim 2 wherein the microchannel comprises a chiral auxiliary.

28. The system of claim 1 wherein the microchannel comprises a chiral auxiliary.

29. The method of claim 2 wherein the system comprises a tethered catalyst composition in which a tether comprises at least a three atom chain that connects a metal center with a surface oxygen.

30. The method of claim 29 comprising a reaction selected from the group consisting of: hydrogenation, dehydrogenation, hydrogenolysis, hydroformylation, hydrosilation, oxidation, reduction, isomerization, aromatization, hydrocyanation, olefin metathesis, carbonylation, decarbonylation, carboxylation, epoxidation, oxygen insertion reactions, oxidation of alcohols to carbonyls and carboxylic acids, olefin polymerization, oxygen transfer, hydrogen transfer, hydrogenation of imines, nitrogen transfer, Heck Reaction, alkylation, amination, cyclopropanation, addition reactions, condensation, hydration, dihydroxylation of olefins, dehydration, Suzuki reaction, Buchwald-Hartig Reaction, Sonogashira Reaction, cross coupling reactions, and esterification.

31. The method of claim 13 comprising a Suzuki reaction.

32. The catalytic system of claim 1, wherein the system comprises a tethered catalyst composition comprises a dendritic catalyst.

33. The method of claim 2 wherein the reactant fluid composition is a liquid having a diffusivity (D_{eff}) of $0.5x10^{-5}$ cm^2/s to $3.5x10^{-5}$ cm^2/s, and the method is carried out with a capture number 100 or less and a residence time of 10,000 s or less.